REMARKS/ARGUMENTS

Reconsideration of this application is requested. Claims 1-5, 8, 12 and 13 will be pending subsequent to entry of this Amendment.

DISCUSSION OF AMENDMENTS TO THE CLAIMS AND SUPPORT FOR SAME

The claims are amended to more closely define the invention.

Claims 2, 4, 12, and 13 are original.

Claims 6, 7, and 9-11 are cancelled without prejudice.

Claim 1 has been amended to recite "a zeolite that has a H-FER structure, or a Na-MOR structure or K-MOR structure in which a pore diameter has been adjusted by ion exchange, and a Si/Al ratio of no more than 20". These amendments are supported by present Examples 1 to 3 and paragraph 0050 of the present specification.

Claims 3 and 8 have been amended to recite "a zeolite that has a H-MFI structure, Na-MFI structure, Ca-MFI structure, Zn-MFI structure, or Cu-MFI structure, and a Si/Al ratio of no more than 20." These amendments are supported by present Examples 4 to 8 and paragraph 0050 of the present specification.

Claim 5 has been amended to recite "a zeolite that has at least one straight channel; a H-FER structure, a Na-MOR structure, or K-MOR structure; and a Si/Al ratio of no more than 20". These amendments are supported by present Examples 1 to 3 and paragraph 0050 of the present specification.

Accordingly, no new matter has been added.

RESPONSE TO PRIOR ART-BASED REJECTIONS

The outstanding Office Action states that Claims 1, 2, 5, 7, and 12 are rejected under 35 U.S.C. 102(b) as being anticipated by Golden et al. (US6,106,593). Also, the outstanding Office Action states that Claims 3, 4, 8-11, and 13 are rejected under 35 U.S.C. 102(b) as being anticipated by Moreau et al. (FR2834915). In addition, the outstanding Office Action states that Claims 5-7 are rejected under 35 U.S.C. 102(b) as being anticipated by Guliants (EP1,078,685).

Therefore, the applicants have amended their claims as described in the above, and respectfully point out the following.

An object of the present invention is to provide a hydrocarbon adsorbent that is capable

of efficiently removing ultra low concentrations of propane from raw air.

In order to achieve this object, the present invention uses zeolite that has the FER structure, MOR structure, or MFI structure, each zeolite having a pore diameter that is essentially equal to a size of a propane molecular ion. In particular, the present invention uses zeolite that has the H-FER structure containing a H ion, the MOR structure containing a Na or K ion, or the MFI structure containing a H, Na, Ca, Zn, or Cu ion. Table 1 of the present specification describes that the adsorption quantities of propane were within a range of 1.6-6.0 mmol/kg in Examples 1-8 in which the zeolites of the present invention were used. In contrast, the adsorption quantities of propane were within a range of 0.65 and 1.0 mmol/kg in Comparative examples 3 and 4 in which the zeolites other than the present invention are used.

As the reasons for these results, it can be considered that H-MOR and H-MFI adsorbents have pore diameters which are considerably large and that a propane molecule with a kinetic diameter of 43 nm (calculated from the Lennard-Jones potential) is unable to obtain sufficient adsorption energy from the pore walls, resulting in a decrease in the adsorption quantity (see paragraph 0050 of present specification). Moreover, the exchangeable ion quantity is minimal in the case of an adsorbent for which the Si/Al ratio exceeds 100, resulting in difficulty in the adjustment of the pore diameter (see paragraph 0050 of present specification).

As the Office Action states, Golden et al. teach an air purification unit including a column packed with a hydrocarbon adsorbent that is a zeolite with a MOR structure (Na-mordenite; Table 1).

However, the object of the invention of Golden et al. is to remove carbon dioxide, water, nitrous oxide and optionally ethylene from a feed air stream (see abstract). There is no description regarding the adsorption of propane using the zeolite with the adjusted pore diameter. Accordingly, Golden et al. do not disclose the technical feature in which a pore diameter of a zeolite is adjusted to adsorb propane.

As the Office Action also states, Moreau et al. teach an air purification unit for a TSA system including a column packed with a zeolite with a MFI structure (Cu-exchanged ZSM-5 zeolite). Also, paragraph 6 on page 5 of Moreau et al. states that a ZSM-5 zeolite can contain a cation such as Cu, Co, Ni, Cr, Fe, or a combination thereof. Moreover, paragraph 5 on page 4 of Moreau et al. states a step of elimination of an impurity selected from saturated CO_2, water, and

hydrocarbons such as propane. Furthermore, paragraph 5 on page 5 of Moreau et al. states that a Si/Al ratio is greater than or equal to 1. In addition, Examples 1 and 2 of Moreau et al. state that the Cu-exchanged ZSM-5 zeolite was used to completely adsorb nitric oxide (0.3 ppm), nitrogen monoxide (1 ppm), ethylene (1 ppm), acetylene (1 ppm), and propylene (1 ppm) in the air.

However, Moreau et al. do not disclose a specific example of the adsorption of propane at a ppb level. In addition, Moreau et al. do not disclose the technical feature in which a pore diameter of a zeolite is adjusted to adsorb propane. In the present invention, the zeolite having a Si/Al ratio of no more than 20 is subjected to pore diameter adjustment in order to specifically adsorb propane. This is because a Si/Al ratio of no more than 20 enables an increase in the ion exchange quantity, i.e. the proportion of ions available for pore diameter adjustment (see paragraph 0050 of the present specification). The Examiner will note that Moreau et al. disclose a Si/Al ratio of greater than or equal to 1, but this disclosure has no technical meaning. In general, a zeolite contains silicon, aluminum, and oxygen, and has a Si/Al ratio within a range from 1 (Si:Al = 1:1) to infinity (Si:Al = 1:0, cf. silicalite). Therefore, Moreau et al. do not disclose or imply the technical feature of a Si/Al ratio of no more than 20 and the efficient adsorption of propane using the zeolite with the adjusted pore diameter

The Office Action argues that Guliants teaches an adsorbent for use in an air purification unit in which the adsorbent is a zeolite having an exchanged FER or MOR structure.

This is not so - Guliants does not disclose an air purification unit but instead the separation of nitrogen gas from gas mixtures containing nitrogen and other gases (see paragraph 0001). In addition, the invention of Guliants relates to a pressure swing adsorption process (see abstract). A pressure swing adsorption process is technically different from a temperature swing adsorption process of the present invention. Moreover, an object of the invention of Guliants is to provide a novel adsorbent that selectively adsorbs nitrogen (see abstract), and the adsorbent having FER or MOR structure is described as a nitrogen adsorbent in Claims 1 and 9 of Guliants. Accordingly, the scope of the invention disclosed in Guliants is different from the present invention, and Guliants does not disclose the technical feature in which a pore diameter of a zeolite is adjusted to adsorb and remove propane.

As explained in detail above, the difference between the present invention and the prior art is the preparation of an adsorbent that is particularly suitable for and tailored to the adsorption

of propane. None of the applied prior art references disclose the selection of the ion species for the pore diameter adjustment and the limitation of a Si/Al ratio of no more than 20 in order to efficiently adsorb a trace quantity of propane at a ppb level. Accordingly, the present invention may also be considered a parameter invention over the prior art.

For at least the reasons set out above, Claims 1, 3, 5, and 8 are allowable.

Also, as rejected Claims 2, 4, 12, and 13 are either directly or indirectly dependent on the allowable Claims 1, 3, 5, and 8, these claims are also allowable; i.e. see MPEP §2143.03.

Reconsideration and favorable action are solicited. Should the examiner require further information, please contact the undersigned.

Respectfully submitted,

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